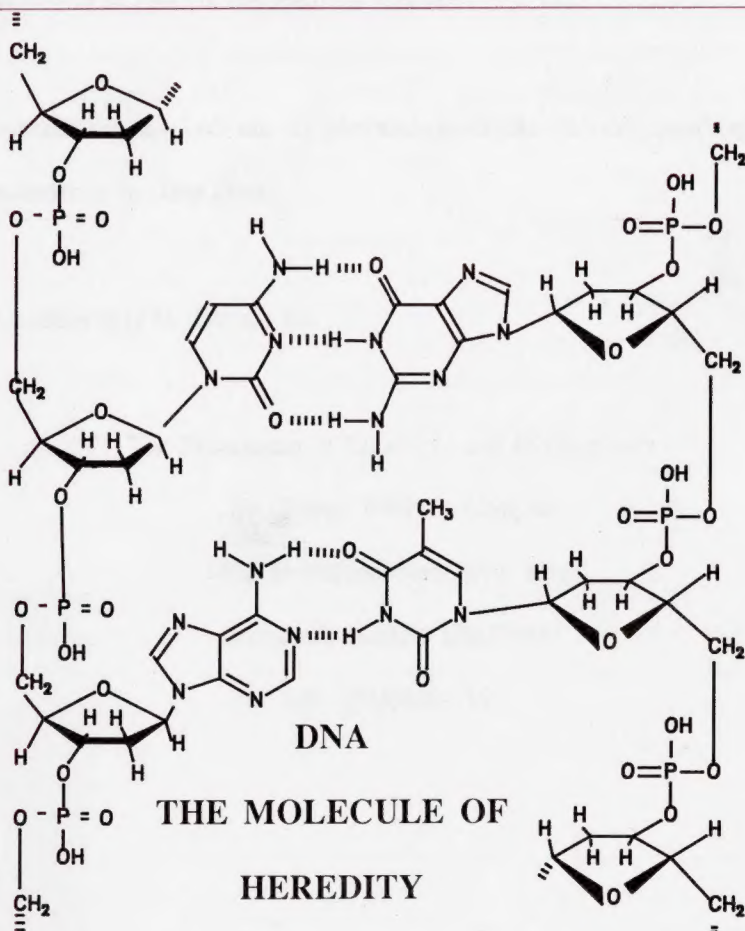




**Concordia**  
UNIVERSITY

**ARTS AND SCIENCE**  
**CHEMISTRY AND BIOCHEMISTRY**



# Concordia

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# CONCORDIA UNIVERSITY

## DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY

### COURSE GUIDE

This guidebook was prepared to give the prospective student an overview of the Department, the facilities and the programmes. Some of the information in this booklet is subject to change. The Official University document is The Undergraduate Calendar.

Students are advised not to purchase textbooks before consulting the professor at the first class.

Questions may be directed to:

The Department of Chemistry and Biochemistry

Sir George Williams Campus

1455 de Maisonneuve Blvd. West

Montreal, Quebec H3G 1M8

Tel: (514)848-3366

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## The Science of Chemistry

"The study of chemistry is profitable, not only inasmuch as it promotes the material interests of mankind, but also because it furnishes us with insight into those wonders of creation which immediately surround us, and with which our existence, life and development are most clearly connected."

Justus Von Liebig (1851)

Science is a systematic study of ourselves and our environment, that is, the physical objects and the phenomena that occur in our world. Science is perhaps the most dominant human endeavour of our time. Through science we have gained some insight into the laws of nature and learned to manipulate the environment to our advantage. Much of modern day living is founded on the advances in science.

Chemistry is a dynamic science which deals with the structure and behaviour of matter. It is concerned with the composition of matter and the changes it undergoes, this includes complex biological material and simple substances, such as water. Chemistry has led to such innovations as drugs and medicines to fight disease, fertilizer and pesticides, gasoline, improved food and clothing, plastics, etc. All of us benefit from the practical applications of chemistry research.

Chemistry, like the other sciences, is very complex and chemists have become specialized. Chemistry has the subdivisions of physical, inorganic, analytical, organic and biochemistry and some of these have narrower subdivisions, such as bioinorganic chemistry. Each is based on the same fundamental principles of chemistry, but deals with a rather specific part of chemistry. These divisions are all inter-dependent. Many of the important discoveries have been the result of team-work involving chemists from the various sub-divisions.

Our cover logo, the simplified and schematic partial structure of a nucleic acid called deoxyribonucleic acid (DNA), the molecule of heredity, was elucidated through the co-operation of all branches of chemistry.

Biochemists isolated the compound, analytical chemists learned its composition, organic chemists studied the structure of components and synthesized models of it. The physical chemists elucidated the overall structure of this huge molecule, using physical methods like X-ray crystallography, and biochemists again studied its function in transmitting all hereditary properties of all living organisms from generation to generation. The importance of all this knowledge cannot be overestimated. The researcher, in close co-operation with colleagues continues to establish the intricate details of the correlation between structure and function.

## **OBJECTIVE OF THE DEPARTMENT**

The Department's aim is to offer the best undergraduate education in chemistry whether it is for a student who is intending to be a specialist, or one who is taking courses in chemistry as a requirement of some other career or for general interest. The faculty and facilities of the department are chosen with this aim in mind. Students are encouraged to meet individually with faculty members.

## **ADMISSION REQUIREMENTS**

Quebec students usually enter the first year of the 90-credit programme after completing the two year CEGEP programme. These students are expected to have completed the "Science Profile" as established through joint action of the Quebec universities and the provincial Department of Education. This profile includes the following courses: Mathematics 103, 203, Physics 101, 201, 301; Chemistry 101, 201 and Biology 301. Graduates of the three year CEGEP technical programme are also admissible.

Students from outside the province may also apply for admission. They may be admitted directly to the 90-credit programme or to an extended credit undergraduate programme depending upon the qualifications submitted. Consult the University Calendar for details.



Students who have not completed collegial studies and are over 21 years of age may apply for admission provided they meet the other criteria as a mature student. Students who wish to use the alternative entry provisions should consult the "Mature Student Programme" in the University Calendar.

All students must make sure that they follow the requirements set out in their letter of admission.

More detail is available in Section 13 of the Undergraduate Calendar.

## **REGISTRATION, COURSE LOADS AND ACADEMIC REGULATIONS**

Each student will receive a package of information regarding the Registration process, which includes the registration dates. It is possible to early register; this avoids long lines and increases the possibility of registering before the various courses are filled. Students must see a Department Advisor who will help in choosing the courses and planning their programme. It is mandatory to have an advisor approve your courses before Registration. You must make an appointment with an advisor:

**Telephone: 848-3355**

Make sure you bring a copy of your academic record and your letter of admission when you meet the advisor.

The normal course load for a full-time student is 30 credits for the academic year. (Note: enrolling in less than 24 credits in an academic year will make a student ineligible for many scholarships, bursaries or loans). Only the Vice-Dean for Student Affairs of the Faculty of Arts and Science can approve a course overload for a student. Please read the Undergraduate Calendar for deadlines (Section 11) and regulations (Section 16) regarding course changes, withdrawals etc. Make sure that you understand the Degree Requirements (Section 31.003) and Academic Performance Regulations (Section 31.003.01) for the Faculty of Arts and Science.

## THE DEPARTMENT AND ITS FACILITIES

A list of the full-time faculty members in the department is shown on the opposite page. Although most courses are taught by full-time faculty, there is a variable number of adjunct professors and part-time lecturers. There are over 18 support staff, which includes technicians, secretaries, laboratory assistants etc. The faculty teach and do research in the major areas of chemistry and biochemistry.

The department's teaching and research laboratories are located at the Sir George Williams Campus.

Some of the major facilities include: The Canadian Centre for Picosecond Laser Spectroscopy, this unit is for flash photolysis on the picosecond and nanosecond time scale; a laser spectroscopy laboratory, X-ray diffraction and nuclear magnetic resonance. Other units, such as the Laboratory for Inorganic Materials and The Science Industrial Research Unit are located within the department.

The department offers graduate programmes at the master and doctoral levels. Full details of these are found in the Graduate Faculty Calendar or through the department's Graduate Programme Director. The faculty is actively involved in research in Analytical Chemistry, Biochemistry, Inorganic Chemistry and Organic Chemistry and they direct master and doctoral students in their thesis work. Our undergraduate students have a first-hand opportunity to engage in a research project with a faculty member of their choice.



## FACULTY

### Chairman and Associate Professor

T.J. Adley

#### Professors

P.H. Bird  
L.D. Colebrook  
N. Serpone  
O.S. Tee

#### Assistant Professors

G. Dénès  
J. Fraser  
P. Joyce  
S. Mikkelsen  
J. Powlowski  
D.K. Sharma  
Y.S. Tsantrizos

#### Associate Professors

M.E. Baldwin  
J.A. Capobianco  
S.J. Daunt  
M. Doughty  
A. English  
Z. Hamlet  
M.G. Hogben  
M.J. Kornblatt  
M.F. Lawrence  
R. Le Van Mao  
R.H. Pallen  
R.T.B. Rye  
G.J. Trudel  
R.A. Westbury  
R.H. Zienius

### UNDERGRADUATE DEPARTMENT ADVISOR

Ms. D. Gordon

Office: H-1139 (Hall Building)

Telephone: 848-3355

Please note that it is mandatory to see the department advisor before registering for courses. It is advisable to make an appointment.

### CHEMISTRY/BIOCHEMISTRY COOPERATIVE EDUCATION PROGRAMME DIRECTOR

Dr. R.H. Zienius

Office: H-1151 (Hall Building)

Telephone: 848-3352

## SCHOLARSHIP, AWARDS, MEDALS, PRIZES AND FINANCIAL AID

A number of scholarships and prizes are available to students in the Department. Some of these are awarded before starting the programme of study at Concordia, such as, Entrance Scholarships, while others are awarded during the course of studies, such as, In-Course Scholarships. There are also Federal and Provincial Loans and Bursaries for eligible candidates. Further information is available in Sections 17 and 18.3 of the Undergraduate Calendar.

## THE COURSE NUMBERS

Course numbers consist of three digits. The first digit is an indication of the level of the course. Two hundred level courses are normally taken during the first year and will have Chemistry 205 and 206 as prerequisites and possibly other 200 level courses. Three hundred level courses are normally taken during second year. These will have 200 level courses as prerequisites and possibly some at the 300 level. The 400 level courses are taken in the final year and will have 300 level courses as prerequisites. They may require some 400 level courses to be taken previously or concurrently.

Students are advised to note the prerequisites carefully when planning their programmes.

The second digit in the course number indicates a field of chemistry. A zero indicates a field of general interest, 1 designates analytical chemistry, 2 designates organic chemistry, 3 physical chemistry, 4 inorganic chemistry, 5 a research course, 7 biochemistry, 8 industrial or environment chemistry and 9 instrumentation.

The third number in the numbering sequence is used to designate the different courses within a field. For example the number 231 would indicate the first course in physical chemistry at the introductory level.

## SUMMER COURSES

There is a limited number of courses offered in the summer session. Most are courses of the second semester of the second year, offered as part of the Chemistry Coop programme schedule. Other students may enrol in these courses if there is space available.

## PROGRAMMES

The Department offers a variety of programmes at difference levels to suit the particular needs of the student. The different areas are Chemistry, Biochemistry and Analytical Chemistry. In addition there are programmes in Geology-Chemistry and a Certificate in Scientific Measurement.

The different levels are the **Honours, Specialization, Major and Minor** programmes. Traditionally Canadian universities required an Honours degree to qualify for admission to a graduate programme. In the Quebec system the Specialization has replaced the Honours programme as the entrance requirement. The difference between the Honours programme and the Specialization programme is the higher performance level demanded in the Honours programme and the inclusion of the Research Project and Thesis, which requires more independent work of the student and the thesis oral defence before the Department. The Specialization programme has the Independent Study and Practicum, which is also a research project with closer supervision, a written thesis and an oral defence before a committee.

**Note:** A graduate with an Honours degree or a Specialization degree, or equivalent in Chemistry or Biochemistry, is eligible for membership in the Quebec Order of Chemists and thus is able to practice as a professional chemist or biochemist in Quebec. A working knowledge of French is required.

Students in a Major programme can become eligible for admission to the Quebec Order of Chemists either by registering for additional courses in Chemistry so that the requirements of the Order are met, or by writing the examinations set by the Order.



(The Quebec Order of Chemists regulates the practice of both chemists and biochemists in Quebec.)

### **Major/Minor**

These programmes do not provide a sufficient depth in chemistry to pursue a career in chemistry. However, they may be combined with programmes in other disciplines where a knowledge of chemistry is useful for the student's chosen career. The major is essentially the core programme, whereas the minor is 24 credits chosen to form a coherent group of courses to complement the student's other areas of study.

### **Exemptions**

A student may be exempted from one or more of the introductory courses, on the basis of work done at CEGEP level. Where exemptions are given, replacement courses must be chosen with the approval of a Department Advisor. In the case of certain programmes approved by the Order of Chemists of Quebec, the courses must be replaced with an equivalent number of credits in the same sub-discipline of the exemptions.

The course composition of these programmes is as follows:

**(Note: A description of each course is given after the section on programmes.)**

**CORE PROGRAMME IN CHEMISTRY (45 Credits)**

	<u>Credits</u>
CHEM. 217 Introductory Analytical Chemistry I	3
CHEM. 218 Introductory Analytical Chemistry II	3
CHEM. 221 Introductory Organic Chemistry I	3
CHEM. 222 Introductory Organic Chemistry II	3
CHEM. 231 Physical Chemistry : Introduction	2
CHEM. 232 (formerly 332) Physical Chemistry : Thermodynamics	2
CHEM. 233 Physical Chemistry: Spectroscopy & Quantum Theory	2
CHEM. 241 Inorganic Chemistry I : Introduction to Periodicity and Valence Theory	3
CHEM. 271 Introductory Biochemistry	3
CHEM. 312 Intermediate Analytical Chemistry	3
CHEM. 324 Organic Chemistry III : Organic Reactions	3
CHEM. 325 Organic Chemistry IV : Organic Structure & Stereochemistry	3
CHEM. 331 Physical Chemistry : Kinetics	2
CHEM. 338 Physical Chemistry Laboratory I	2
CHEM. 339 Physical Chemistry Laboratory II	2

and

Students in Biochemistry programmes will also take

CHEM. 374 Macromolecular Synthesis	3
CHEM. 375 Intermediary Metabolism	3

or

Students in the other programmes will also take

CHEM. 242 Inorganic Chemistry II : The Chemistry of the Main Group Elements	3
CHEM. 341 Inorganic Chemistry III : The Transition Metals	3

**SPECIALIZATION IN CHEMISTRY (60 Credits)**

<b>Core Programme Courses</b>	<b>45</b>
MATH.220 Mathematical Methods in Chemistry	3
CHEM.419* Independent Study and Practicum	6
Additional credits in Chemistry	6

**Note:** Under some circumstances CHEM. 450 may be substituted for CHEM. 419

\*requires Department permission

**SPECIALIZATION IN BIOCHEMISTRY (69 Credits)**

<b>Core Programme Courses</b>	<b>45</b>
BIOL. 261 Genetics	3
BIOL. 270 Introductory Microbiology	3
BIOL. 364 Cell Physiology	3
CHEM. 479 Advanced Biochemistry Laboratory	3*

and 6 Credits chosen from:

CHEM. 471 Enzyme Kinetics & Mechanism	
CHEM. 472 Chemical Toxicology	
CHEM. 473 Medicinal Chemistry I	
CHEM. 474 Medicinal Chemistry II	6
CHEM. 478 Hormone Biochemistry	
CHEM. 481 Bioinorganic Chemistry	

(In certain cases an appropriate CHEM. 498 may be substituted for one of these courses.)

and

CHEM. (a 400-level course)	3*
BIOL. (a 400-level course)	3

**\*These 6 credits may be replaced with CHEM. 450, with Departmental approval.**



**SPECIALIZATION IN ANALYTICAL CHEMISTRY (63-64 Credits)**

<b>Core Programme Courses</b>	<b>45</b>
CHEM. 290 Laboratory Automation and Data Handling	3
CHEM. 328 Analytical Organic Chemistry & Spectroscopy	3
CHEM. 392 Introductory Instrumentation	
or	3
PHYS. 295 Experimental Electronics I (2 credits)	
and	4
PHYS. 296 Experimental Electronics II (2 credits)	
CHEM. 398* Selected Topics in Chemistry	
or	3
CHEM. 498* Advanced Topics in Chemistry	
CHEM. 419* Independent Study and Practicum	
or, with permission	6
CHEM. 450* Research Project and Thesis	
<b>*(These must be Analytical Chemistry)</b>	

**HONOURS IN CHEMISTRY/HONOURS IN BIOCHEMISTRY**

The programmes are similar to the Specialization programmes with the exception that the student must do a Research Project and Thesis (CHEM. 450), which must be defended before the Department. There is also an academic requirement that an Honours student must maintain an average of "B" in all courses in the Honours component of the programme; the minimum acceptable grade in any one of these courses is "C".

An Honours student must have a minimum average of "B-" over courses in the Honours component of the programme taken in each academic year. For courses outside the Honours component of the degree programme, the student must have an average of no less than "C", the minimum acceptable grade in these courses is "D".

To enter an Honours programme, students must apply to the Department Honours Advisor, after they have completed 30 credits at the University, (but not requiring fewer than 30 credits to graduate). The academic grades in the courses completed must meet the requirement noted above.

**MAJOR IN CHEMISTRY (45 Credits)**

This programme is composed of the courses described in the Core Programme. With prior approval of the Department Advisor, courses in related fields may be used as substitutions up to a maximum of 9 credits.

**MAJOR IN BIOCHEMISTRY (45 Credits)**

This programme consists of the Core Programme, but without CHEM. 232, 312, 338 and 339, which are replaced by 9 credits chosen from CHEM. 479, BIOL. 261, 270 and 364.

**MINOR IN CHEMISTRY (24 Credits)**

This programme consists of courses chosen from the Department's offerings that form a coherent pattern to complement the student's other areas of interest. The courses chosen must have prior approval by a Department programme advisor.

**SPECIALIZATION IN GEOLOGY-CHEMISTRY (78 Credits)**

This is a joint specialization consisting of courses offered by both departments. This programme is described in the Undergraduate Calendar, see Geology Department, Section 31.140.

(Note: graduates from this programme are not eligible for membership in the Order of Chemists of Quebec).

**CERTIFICATE IN SCIENTIFIC MEASUREMENT (Chem.Option)**  
(33 Credits)

This programme is designed to meet some very specific needs.

CHEM. 217	Introductory Analytical Chemistry I	3
CHEM. 218	Introductory Analytical Chemistry II	3
CHEM. 290	Laboratory Automation and Data Handling	3
CHEM. 312	Intermediate Analytical Chemistry	3
CHEM. 392	Introductory Instrumentation	3
CHEM. 491	Advanced Instrumentation	4
PHYS. 295	Experimental Electronics I	2
PHYS. 296	Experimental Electronics II	2
PHYS. 396	Computer Electronics	5
PHYS. 397	Experimental Medical Electronics	5

**COOPERATIVE EDUCATION PROGRAMME**

The "Coop" Programme in Chemistry/Biochemistry has the same academic course requirements as the Honours or Specialization programmes taken by "regular stream" undergraduates. However, Coop students alternate their academic semesters with off-campus paid work terms in government or industrial laboratories where they are employed as chemists/biochemists in-training. Students who are above average academically, and interested in the Coop Programme should refer to the announcement in the Undergraduate Calendar, Section 31.515. In addition, more specific information may be obtained from the Director of the Chemistry/Biochemistry Coop Programme, Dr. Raymond H. Zienius (Telephone: 848-3352), or from the Institute for Cooperative Education (Telephone: 848-3953).



## SCIENCE COLLEGE

Students planning to register in one of the programmes of the Department might consider joining the Science College. In the Science College students will gain an understanding of several areas of science while specializing in one that they choose. It is an opportunity to become acquainted with science as practiced and understood by scientists today. The goals of the Science College are to provide an opportunity for experience in a research environment, for thinking about the nature of science, and for becoming aware of the style and content of the various scientific disciplines. Students planning to register in a Specialization or a Major in the Department of Chemistry and Biochemistry are eligible for admission to Science College provided they meet the other entrance requirements of the College. See Section 31.550 of the Undergraduate Calendar or telephone 848-2595.

## **PROPOSED: NEW PROGRAMMES**

### **BIOCHEMISTRY**

Three new programmes have been developed as a joint undertaking by the Department of Chemistry and Biochemistry and the Department of Biology. These are: Specialization in Biochemistry, Specialization in Biochemistry and Molecular Biology and a Specialization in Cellular and Molecular Biology. It is expected that these programmes will be approved for the 1994-95 academic year.

The objective of the new programmes is to provide students, in both departments, with a thorough education in biochemistry, cell biology and molecular biology, including an extensive laboratory experience, based on the current advances in these disciplines.

Although these three programmes have many requirements in common, they are designed to meet the needs of different groups of students. The Specialization in Biochemistry is for students with a strong interest in chemistry. This programme should fulfil the requirements of the Quebec Order of Chemists. The Specialization in Biochemistry and Molecular Biology is directed at students who are interested in biological aspects of biochemistry. The Specialization in Cellular and Molecular Biology will be offered by the Department of Biology; it contains more biology and much less chemistry.

Courses chosen in consultation with the Academic Advisor of the Department can minimize any difficulties in transferring to the new programmes when they are approved.

B.Sc. Specialization in Courses		Biochemistry (66 Credits)	Biochemistry & Molecular Biol. (66 Credits)
Chem. 217	Analytical Chemistry I	3	3
Chem. 218	Analytical Chemistry II	3	3
Chem. 312	Analytical Chemistry III	3	-
Chem. 221	Organic Chemistry I	3*	3#
Chem. 222	Organic Chemistry II	3*	3#
Chem. 324	Organic Chemistry III	3	3
Chem. 325	Organic Chemistry IV	3	-
Chem. 271	Biochemistry I	3	3
Chem. 37X	Biochemistry II	3	3
Chem. 479	Advanced Biochem. Lab	3	3
Chem. 241	Inorganic Chemistry I	3	3
Chem. 23X	Physical Chemistry I	3	3
Chem. 23Y	Physical Chemistry II	3	-
Chem. 33A	Physical Chemistry III	3	3
Chem. 33Z	Biophysical Chemistry	3	3
Biol. 263	Molecular & General Genetics	3	3
Biol. 364	Cell Physiology	3	3
Biol. 366	Cell Biology	3	3
Biol. 367	Molecular Biology	-	3
Biol. 368	Laboratory: Genetics/Cell Biol.	3	3
Biol. 491	Adv. Lab. Molecular Biology	3	3

#### **Specialization Biochemistry:**

In addition - 6 Credits of 400 Level Biochemistry  
3 Credits may be replaced by Biol. 367 or  
Cell and Molecular Biology

#### **Specialization Biochemistry & Molecular Biology:**

In addition - 12 Credits of 400 Level Biochemistry and  
Cell & Molecular Biology with at least  
3 Credits in each area.

**\*Exemptions for CHEM. 221 & 222 must be replaced with Organic Credits**

**#Exemptions for these course may be replaced with Chemistry or Biology Credits.**



## COURSE DESCRIPTIONS

**Note:** This list of courses does not imply that all of these courses will be offered in any particular year. Students must refer to the current schedule of courses for this information.

This section contains general descriptions of course contents. The names of the instructors are those that have taught the course recently and there may be changes, depending upon scheduling and work-loads. No text books are listed. Students are cautioned against buying textbooks, references, etc. without the advice of the instructor at the first class.

Courses that consist of both laboratories and lectures require that a satisfactory performance be obtained in each of the components for successful completion of the course.

### Chemistry 205 General Chemistry I 3 credits

**Instructors:** M. Doughty, R.H. Pallen, G.J. Trudel

**Prerequisites:** none

**For:** Mature Students and students who have not taken CEGEP level chemistry, students who wish to obtain some knowledge of chemistry or to continue in chemistry. This course, together with Chem. 206, is a prerequisite for all other courses in chemistry except Chem. 208.

**Format:** Lectures and laboratories are given in alternating weeks.

**Basis of Grading:** Combination of tests, lab. work and final exam.

**Description:** This course is intended to provide students with a knowledge of basic concepts in chemistry. Among the topics discussed are stoichiometry; states of matter, atomic and molecular structure, the periodic table and periodicity and chemical bonding.

**Note:** Students in programmes leading to the B.Sc. degree may not take this course for credit to be applied to their programme of concentration.

**Chemistry 206 General Chemistry II** 3 credits

**Instructors:** M. Doughty, R.H. Pallen

**Prerequisites:** Chemistry 205

**For:** Same as Chemistry 205

**Format:** Lectures and laboratories are given in alternating weeks.

**Basis of Grading:** Combination of tests, lab. work and final exam.

**Description:** Thermochemistry, solutions and their properties, equilibrium, ionic equilibria, pH, buffers, kinetics, reaction mechanisms, other selected topics related to biochemistry, biology, and engineering.

**Note:** Students in programmes leading to the B.Sc. degree may not take this course for credit to be applied to their programme of concentration.

**Chemistry 208 Chemical Hazards in the Work Environment** 3 Cr.

**Instructor:** M. Hogben

**Prerequisites:** none

**For:** Students not registered for a B.Sc.

**Format:** Lectures

**Basic of Grading:** Term paper, mid-term and final exams.

**Description:** An introduction to chemistry, chemical hazards and the social history of chemistry. Toxicity, combustion, corrosion, explosives, radiation and water reactive materials in the work environment are studied. An aim of the course is to help the student establish the chemical vocabulary and concepts necessary to understand the social impact of chemistry in relation to occupational health and safety, firefighting and environmental hazards. No previous knowledge of chemistry is assumed since the non-quantitative knowledge is developed throughout the course.

**Note:** This course may not be taken for credit by science students.

**Chemistry 217 Introductory Analytical Chemistry I** 3 credits

**Instructors:** A. English, S. Mikkelsen, G.J. Trudel, R.H. Zienius

**Prerequisites:** CEGEP Chem 201, Phys. 301, Math 102, 203 or equiv.

**For:** Degree programmes in chemistry and biochemistry and certificate in measurement.

**Format:** Lectures and laboratory.

**Basis of Grading:** Class tests, final exam, lab work

**Description:** An introduction to the basic theories involved in analytical chemistry, as demonstrated by acid/base, complexations and solubility product equilibria. The laboratory gives practice in the classical methods of gravimetric and volumetric methods of analysis, which are fundamental procedures used to obtain the most accurate results in modern analytical chemistry.

**Note:** Students who have received credit for CHEM. 211 or GEOL. 324 may not take this course for credit.

**Chemistry 218 Introductory Analytical Chemistry II** 3 Credits

**Instructors:** A. English, S. Mikkelsen, R.H. Zienius

**Prerequisites:** Chem. 217

**For:** Degree programmes in chemistry and biochemistry and certificate in measurement.

**Format:** Lectures and laboratory.

**Basis of Grading:** Class tests, final exam, lab work

**Description:** A continuation of the study of basic theories of analytical chemistry as applied to precipitation titration and redox equilibria. This is followed by an introduction to the more commonly used instrumental analytical techniques, including: potentiometry and molecular, atomic and fluorescence spectroscopy. The laboratory provides practice in the use of basic instrumentation.

**Note:** Students who have received credit for CHEM. 211 or GEOL. 324 may not take this course for credit.

**Chemistry 221 Introductory Organic Chemistry I** 3 Credits

**Instructors:** T.J. Adley, L.D. Colebrook, M. Doughty

**Prerequisites:** Chemistry 206 or equivalent

**For:** All programmes in chemistry, biochemistry, biology and exercise science

**Format:** Lectures and laboratory.

**Basis of Grading:** Midterm and final exams, laboratory work.

**Description:** Basic aspects of orbitals and their role in covalent bonding. Acids and bases. Delocalization of electrons. Alkanes, their structures, isomerism and nomenclature. Introductory stereochemistry. Enantiomers, diastereomers, conformers, Fischer projections, Cahn-Ingold-Prelog sequence rules for specification of chirality. E/Z-isomerism. Conformations of cyclic compounds. Alkyl halides,  $S_N1$ ,  $S_N2$ , E1, E2 reactions, their mechanisms and stereochemistry. Free-radical reactions, organometallic compounds. Chemistry of alcohols, ethers and related compounds.

**Chemistry 222 Introductory Organic Chemistry II** 3 credits

**Instructors:** T.J. Adley, M.E. Baldwin, M. Doughty, Z. Hamlet

**Prerequisites:** Chem. 221 or equivalent

**For:** All degree programmes in chemistry, biochemistry, biology and exercise science.

**Format:** Lectures and laboratory.

**Basis of Grading:** Laboratory work, midterm and final exams.

**Description:** Introduction to the use of IR and NMR spectroscopy for identification of simple organic compounds. Chemistry of alkenes, alkynes and dienes. Electrophilic additions, Markovnikov's rule, conjugate additions, Diels-Alder reaction, polymerization. Benzenes, Huckel rule and aromaticity. Electrophilic aromatic substitution, its mechanism and orientation. Chemistry of aldehydes and ketones. Reduction, Wittig, and Grignard reactions. Aldol condensation. Chemistry of carboxylic acids and their derivatives. Chemistry of amines. Simple reaction mechanisms.



**Chemistry 231 Physical Chemistry : Introduction**    2 credits

**Instructors:** A. Peters, D. Sharma, R.A. Westbury

**Prerequisites:** CEGEP Chem. 201, Phys. 301, Math. 103, 203 or equiv.

**For:** Degree programmes in chemistry, biochemistry, and analytical chemistry.

**Format:** Lectures

**Basis of Grading:** Midterm and final exams

**Description:** First law of thermodynamics, thermochemistry, entropy, the second and third laws of thermodynamics, free energy and chemical equilibrium, electrochemical cells and the Nernst equation, the Gibbs-Helmholtz equation. Applications of thermodynamics to systems of chemical interest.

**Chemistry 232 Physical Chemistry : Thermodynamics**    2 credits

**Instructors:** A. Peters, R.A. Westbury

**Prerequisite:** Chem. 231

**For:** Degree programmes in chemistry, biochemistry, and analytical chemistry.

**Format:** Lectures

**Basis of Grading:** Midterm and final exams

**Description:** Comparison of closed and open systems, partial molal quantities, chemical potential, real gases, fugacity, equilibrium constant, free energy function, ideal solutions, real solution, Duhem-Margules equation.

**Note:** Students who have received credit for CHEM. 332 may not take this course for credit.

**Chemistry 233 Physical Chemistry : Spectroscopy and Quantum Theory**    2 credits

**Instructors:** M.F. Lawrence, R.T. Rye, D. Sharma, R.A. Westbury

**Prerequisites:** CEGEP Chemistry 201, Physics 301 or equiv. and Math. 220

**For:** Degree programmes in chemistry, biochemistry, and analytical chemistry.

**Format:** Lectures

**Basis of Grading:** Midterm and final exams

**Description:** This course is intended to introduce the student to the basic ideas of quantum mechanics, spectroscopy and the electronic structure of atoms and molecules. Topics covered include the origins and postulates of quantum theory; applications to simple systems; the hydrogen atom; the aufbau principle of the elements; simple molecules. Spectroscopy and spectroscopic measurements; simple atomic spectra; infra-red and Raman spectra of simple molecules, fluorescence, N.M.R.

**Chemistry 241 Inorganic Chemistry I : Introduction to Periodicity and Valence Theory**    3 credits

**Instructors:** P.H. Bird, J.A. Capobianco, M.G. Hogben, N. Serpone

**Prerequisites:** CEGEP Chem. 201, Phys. 301, Math 103, 203 or equiv.

**For:** Degree programmes in chemistry, biochemistry, and analytical chemistry.

**Format:** Lectures, problem sessions and laboratory

**Basis of Grading:** Assignments, mid-term and final exams

**Description:** The structure of the atom, and its use in explaining the periodic table and properties of atoms; covalent bonding treatments - including Lewis Theory; the Valence Shell Electron Pair Repulsion Theory of structure, the valence bond and the molecular orbital theories of bonding. Crystal Field Theory applied to the structure and properties of transition metal complexes. Bonding theories of metallic materials and semi-conductors.

**Chemistry 242 Inorganic Chemistry II. Chemistry of the Main Group Elements**    3 credits

**Instructors:** G. Dénès, M.G. Hogben

**Prerequisites:** CEGEP Chem. 201, Phys. 301, Math 103, 203 or equiv.

**For:** Degree programmes in chemistry and analytical chemistry

**Format:** Lectures and laboratory

**Basis of Grading:** Assignments, mid-term and final exams

**Description:** A survey of the properties and reactions of: Hydrogen, Group I (IA) (Lithium to Cesium) and Group 2 (IIA) (Beryllium to Radium), Group 11 (IB) (Copper to Gold), Group 12 (IIB) (Zinc to Mercury), Group 13 (IIIA) (Boron to Thallium), Group 14 (IVA) (Carbon to Lead), Group 15 (VA) (Nitrogen to Bismuth), Group 16 (VIA) (Oxygen to Tellurium), Group 17 (VIIA) (Fluorine to Astatine), Group 18 (VIII A) (Helium to Radon).

**Chemistry 271 Introductory Biochemistry**    3 credits

**Instructors:** J. Fraser, M.J. Kornblatt

**Prerequisite:** Chem. 222

**For:** Degree programmes in chemistry, biochemistry and analytical chemistry

**Format:** Lectures and laboratory

**Description:** This course is an introduction to the essentials of biochemistry. Topics discussed are protein structure, enzymology, carbohydrate metabolism and its regulation; an overview of bioenergetics, nucleic acids and protein biosynthesis.

**Note:** Students who have received credit for CHEM. 371 or CHEM. 372 or CHEM. 373 may not take this course for credit.

**Chemistry 290 Laboratory Automation and Data Handling** 3 cr.

**Instructor:** R.A. Westbury

**Prerequisites:** Comp. 212 or equivalent, Chem. 218 previously or concurrently and permission of the department

**For:** Specialization in analytical chemistry

**Format:** Lectures, tutorials and laboratory

**Basis of Grading:** Laboratory work, midterm and final exams

**Description:** Introduction to some modern techniques used to transduce and manipulate raw chemical data. Topics to be discussed will include: statistical treatment of chemical data, using programmes written in Basic, or other high-level language; the use of binary, decimal, and hexadecimal numbers; programming a single-board computer or modern microcomputer using machine and assembly languages; input-output operations; elementary interfacing techniques. Experiments will involve the collection and treatment of data for common laboratory instruments such as electrodes and photodetectors.

**Chemistry 302 Industrial Chemistry, Resources and Environment**

2 credits

**Instructor:** M.G. Hogben

**Prerequisites:** Students must be registered in a programme in chemistry and be within 42 credits of graduation or permission of the dept.

**For:** Optional Course

**Format:** Lectures

**Basis of Grading:** Tests and final exam

**Description:** An introduction to chemical engineering for chemists.

Management and conservation of resources; pollution control; occupational and environmental health; technological and environmental impact assessment.



**Chemistry 304 Chemical Technology and Human Values 3 credits**

**Instructor:** M.G. Hogben

**Prerequisites:** Must be registered in a Chemistry programme and be within 42 credits of graduation, or permission of the Department.

**For:** Optional course

**Format:** Lectures

**Basis of Grading:** Tests and final exam

**Description:** The history of technology; the impact of chemistry on material life; appropriate technologies; chemistry and war; the social responsibility of the scientist.

**Note:** Students who have received credit for CHEM. 303 may not take this course for credit.

**Chemistry 312 Intermediate Analytical Chemistry 3 credits**

**Instructors:** M.F. Bell, R.H. Zienius

**Prerequisite:** Chem. 218

**For:** Degree programmes in chemistry, biochemistry, and analytical chemistry

**Format:** Lectures and laboratory

**Basis of Grading:** Mid-term and final exams, laboratory work

**Description:** This course is a continuation of Chem. 218 with emphasis on instrumental analysis. Techniques discussed include emission spectroscopy; X-ray spectroscopy; voltammetry and polarography, amperometric titrations; coulometry and coulometric titrations; conductometry; chromatography with particular emphasis on gas chromatography and high performance liquid chromatography. Laboratory work is done concurrently and provides experience in the techniques discussed in lectures.

**Note:** Students who have received credit for any of CHEM.310, CHEM. 314, CHEM. 315 or CHEM. 319, may not take this course for credit.

**Chemistry 324 Organic Chemistry III : Organic Reactions 3 cr.**

**Instructors:** M.E. Baldwin, Z. Hamlet

**Prerequisite:** Chem. 222 or equivalent, Chem. 331 previously or concurrently.

**For:** Degree programmes in chemistry, biochemistry, and analytical chemistry

**Format:** Lectures and laboratory

**Basis of Grading:** Mid-term and final exams, laboratory work.

**Description:** This course is a mechanistic survey of reactions of major synthetic utility. It deals with reaction mechanisms and the importance of reactive intermediates such as carbocations, carbanions, radicals and carbenes.

**Note:** Students who have received credit for CHEM. 322 may not take this course for credit.

**Chemistry 325 Organic Chemistry IV : Organic Structure and Stereochemistry 3 credits**

**Instructors:** T.J. Adley, Z. Hamlet

**Prerequisites:** Chem. 222 or equivalent,, Chem. 331 previously or concurrently

**For:** Degree programmes in chemistry, biochemistry, and analytical chemistry

**Format:** Lectures and laboratory

**Basis for Grading:** Mid-term and final exams, laboratory work.

**Description:** The course examines organic structure and stereochemistry including the relationship of stereochemistry to physical properties and chemical reactivity. The use of chemical and spectroscopic means to determine structure and stereochemistry is included. The laboratory work involves the identification of organic compounds.

**Note:** Students who have received credit for CHEM. 321 may not take this course for credit.

**Chemistry 326 Natural Products 3 credits**

**Instructors:** L.D. Colebrook, Y.S. Tسانtrizos

**Prerequisite:** Chem. 222 or equivalent

**For:** Optional course

**Format:** Lectures

**Basis of Grading:** Mid-term and final exams

**Description:** The study of natural products has long been associated with the development of Organic Chemistry. Indeed, the very term "organic" reflects the mid-nineteenth century distinction between the "vital" compounds of living organisms and the inorganic chemistry of minerals. The structure, mechanism of action and biosynthetic origin of biologically important compounds such as fatty acids, polyketides, terpenes, steroids, alkaloids and  $\beta$ -lactam antibiotics will be discussed. The role of traditional organic chemistry in the development of modern biochemistry and biotechnology will be illustrated with examples from recent studies which have led to discoveries of enormous benefit to medicine and agriculture.

**Note:** Students who have received credit for Chem. 398A may not take this course for credit.

**Chemistry 327 Organic Chemistry of Polymers 3 credits**

**Instructor:** R.H. Pallen

**Prerequisites:** Chem. 222 or equivalent

**For:** Optional course

**Format:** Lectures

**Basis of Grading:** Mid-term and final exams

**Description:** Introduction to the fundamental aspects of polymers and polymerization. Methods of preparation, reaction mechanisms of polymer synthesis. Includes the various types of mechanism: condensation, free radical, anionic, cationic and Ziegler-Natta or heterogeneous polymerizations.

**Chemistry 328 Analytical Organic Chemistry and Spectroscopy**

3 credits

**Instructor:** T.J. Adley

**Prerequisites:** Chem. 217, 218, 222 and 233

**For:** Specialization in Analytical Chemistry

**Format:** Lectures and laboratory

**Basis of Grading:** Mid-term, final exams and laboratory work

**Description:** Principles of physical, chemical and instrumental methods of identification and analysis of organic compounds. 'Wet' chemistry as a means of functional group identification. Protocol of identification of unknown organic compounds by chemical and spectroscopic methods. Application of vibrational, electronic, nuclear magnetic resonance and mass spectrometric techniques in the elucidation of structure of organic compounds.

**Note:** Students who have received credit for CHEM. 311 and CHEM. 316, or CHEM. 391 may not take this course for credit.

**Chemistry 331 Physical Chemistry : Kinetics** 2 credits

**Instructors:** R.T. Rye, O.S. Tee

**Prerequisites:** CHEM. 233

**For:** Degree programmes in chem., biochem., and analytical chem.

**Format:** Lectures

**Basis of Grading:** Mid-term, final exams and assignments

**Descriptions:** Kinetic molecular theory. Topics in chemical-reaction kinetics, including: mechanisms of elementary reactions; theories of chemical reaction rates; free-radical reactions; factors influencing rates of reactions in solution; acid-base catalysis; catalysis by enzymes; the Michaelis-Menten mechanism; inhibition in enzyme-catalyzed reactions.



**Chemistry 338 Physical Chemistry Laboratory I: 2 credits**

**Instructor:** R. Le Van Mao

**Prerequisite:** Chem. 231, previously or concurrently.

**For:** Degree programmes in chemistry, biochemistry and analytical chemistry.

**Basis of Grading:** Laboratory work and reports.

**Descriptions:** Introduction to experimental procedures involved in determining basic physical properties of solids, liquids, and gases.

**Note:** Students who have received credit for CHEM. 238 and/or CHEM. 239 may not take this course for credit.

**Chemistry 339 Physical Chemistry Laboratory II: 2 credits**

**Instructor:** R. Le Van Mao

**Prerequisite:** Chem. 331; Chem. 232, previously or concurrently.

**For:** Degree programmes in chemistry, biochemistry and analytical chemistry.

**Format:** Laboratory

**Basis of Grading:** Laboratory work and reports.

**Description:** Investigation of some interactions that occur between solids, liquids, and gases. Kinetic and mechanistic studies of chemical reactions.

**Note:** Students who have credit for CHEM. 330 and/or CHEM. 337 may not take this course for credit.

**Chemistry 341 Inorganic Chemistry III : The Transition Elements****3 credits****Instructors:** P.H. Bird, J.A. Capobianco**Prerequisites:** Chem. 211, 241, 242**For:** Degree programmes in chemistry and analytical chemistry**Format:** Lectures and laboratory**Basis of Grading:** Mid-Term, final exam and laboratory work

**Description:** Theories of bonding in transition metal complexes, including ligand field theory, applied to structure, physical properties, and reactivity of transition metal complexes: organometallic chemistry and catalysis. Metal in biological systems. Lectures and laboratory.

**Note:** Students who have received credit for CHEM. 342 or CHEM. 348 may not take this course for credit.

**Chemistry 374 Macromolecular Synthesis**    3 credits

**Instructor:** J. Fraser

**Prerequisite:** Chem. 271

**For:** Specialization biochemistry

**Format:** Lectures and problem sessions

**Basis of Grading:** Mid-term and final exams

**Description:** Synthesis of proteins, nucleic acids, lipids; synthesis and assembly of complex structures such as membranes, ribosomes, etc.  
Lectures and problem sessions.

**Note:** Students who have received credit for CHEM. 371 or CHEM. 372 or CHEM. 373 may not take this course for credit.

**Chemistry 375 Intermediary Metabolism**    3 credits

**Instructors:** M.J. Kornblatt, J. Powlowski

**Prerequisite:** Chem. 271

**For:** Specialization biochemistry

**Format:** Lectures and laboratory

**Basis of Grading:** Mid-term and final exams, lab. work and reports.

**Description:** This course surveys selected pathways in intermediary metabolism including their regulation and physiological significance; the urea cycle; fatty acid oxidation; biosynthesis of nucleosides, tetrapyrroles, carotenoids, cholesterol and steroidal hormones. The biosynthesis of vitamins and cofactors and the metabolism of selected aminoacids may also be discussed.

**Note:** Students who have received credit for Chem. 371 or 372 or 373 may not take this course for credit.

**Chemistry 392 Introductory Instrumentation**    3 credits

**Instructor:** R.A. Westbury

**Prerequisite:** Chem. 218 or two-6 credit Biol. courses with laboratory

**For:** Optional course

**Format:** Lectures and laboratory

**Basis of Grading:** Mid-term, final and lab. exam

**Description:** Introduction to measurement principles. Instrument design and basic techniques; analysis of amplifiers, integrators, filter circuits, and other basic modules used in chemical instrumentation. In the laboratory, transistor and IC circuits are studied, as well as some of the mechanical, optical and electrical transducers and recorders used in modern chemical instrumentation.

**Note:** Students who have received credit for CHEM. 390 or CHEM. 397 or CHEM. 399 may not take this course for credit.

**Chemistry 398 Selected Topics in Chemistry**    3 credits

Courses under this number and heading are scheduled as the demand and opportunity arises. There is no guarantee that a particular topic will be scheduled in any particular year. Students are advised to consult the schedule.

Topics that have been offered in the past few years are noted below:

Chem. 398A Natural Products (See Chem. 326)                      3 credits

Chem. 398B Bioorganic Chemistry                                      3 credits



**Chemistry 412 Statistical Methods in Chemistry** 3 credits

**Instructor:** R.A. Westbury

**Prerequisite:** Chem. 218

**For:** Optional course

**Format:** Lectures

**Basis of Grading:** Assignments, mid-term and final exam

**Description:** A study of some of the methods used by chemists to analyze data, systematically collate data, and plan the efficient collection of further data. As much as possible, the class discussions will draw upon chemical examples, but there will not be a heavy emphasis on theoretical proofs. Use of the University's computers is encouraged for doing assignments.

**Note:** See Chem. 498Z

**Chemistry 419 Independent Study and Practicum** 6 credits

**Instructor:** The faculty

**Prerequisites:** A grade of C (grade point average of 2.00) in 31 credits of the core programme courses, acceptance by a supervisor, confirmation by the Coordinator of Senior Thesis (Dr. R.H. Zienius). This must be done before registering in course.

**For:** All Specialization programmes (except biochemistry)

**Format:** Laboratory and conferences

**Basis of Grading:** Written report of laboratory work and oral examination by a committee of Department members.

**Description:** In collaboration with and under the direction of a faculty member, the student carries out independent study and practical work on a problem chosen from the student's area of concentration.

**Chemistry 421 Physical Organic Chemistry** 3 credits

**Instructor:** O.S. Tee

**Prerequisites:** Chem. 322 (or Chem. 325), 331

**For:** Optional course

**Format:** Lectures

**Basis of Grading:** Assignments and final exam

**Description:** Determination of organic reaction mechanisms using kinetics, activation parameters, acid-base catalysis, Bronsted catalysis law, solvent effects, medium effects, isotope effects, substituent effects and linear free energy relationships.

**Chemistry 422 Organic Synthesis** 4 credits

**Instructors:** T.J. Adley, Y.S. Tsantrizos

**Prerequisite:** Chem. 322 or Chem. 325

**For:** Optional course

**Format:** Lectures and laboratory

**Basis of Grading:** Assignments, laboratory work, final exam

**Description:** Consideration of synthetic strategy and synthesis design. Modern synthetic methods and reagents, exemplified by syntheses of terpenes, alkaloids, pheromones, and novel structures.

**Chemistry 423 Heterocyclic Chemistry**    3 credits

**Instructor:** O.S. Tee

**Prerequisites:** Chem. 322 or Chem. 325

**For:** Optional course

**Format:** Lectures

**Basis of Grading:** Assignments, final exam

**Description:** Survey of the chemistry of 3-,4-,5-, and 6- membered heterocycles, with a particular emphasis on heteroaromatic systems. Synthesis and reactions of heterocycles; their use in synthesis; factors affecting their reactivity.

**Note:** Students who have received credit for CHEM. 498K may not take this course for credit.

**Chemistry 441 Single Crystal X-Ray Diffraction**    3 credits

**Instructor:** P.H. Bird

**Prerequisites:** Chem. 325

**For:** Optional course

**Format:** Lectures

**Basis of Grading:** Assignments and final exam.

**Description:** Space group symmetry, diffraction of X-rays by single crystals, photographic and counter methods of diffraction data collection. Solution and refinement of crystal structures. Interpretation of atomic coordinates and vibrations.

**Note:** Students who have received credit for Chem. 498I may not take this course for credit.

**Chemistry 442 Physical Methods in Inorganic Chemistry** 3 credits**Instructor:** P.H. Bird**Prerequisites:** Chem. 328, 341**For:** Optional course**Format:** Lectures**Basis of Grading:** Assignments**Description:** Introduction to symmetry and the character tables.

Diffraction methods, X-ray, ESCA, UV-Visible, ORD and CD, EPR, Mössbauer, NQR, NMR, IR, and Raman.

**Chemistry 444 Mössbauer Spectroscopy and Magnetic Properties of Materials** 3 credits**Instructor:** G. Dénès**Prerequisites:** Chem. 241, 242, and 341 previously or concurrently**For:** Optional course**Format:** Lectures**Basis of Grading:** Class tests, assignments, final exam.**Description:** Introduction to the crystalline state, X-ray and neutron

diffraction. Vibrational properties of solids, phonons. Magnetic properties of materials: diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism, ferrimagnetism and other ordered states. Theory of the Mössbauer effect, hyperfine interactions. Examples of Mössbauer studies: iron, tin, other main group elements, other transition elements, lanthanides and actinides. Combined studies of solids by X-ray and neutron diffractions, magnetic measurements and Mössbauer spectroscopy.

**Note:** Students who have received credit for CHEM. 498M may not take this course for credit.



**Chemistry 445 Heterogeneous Catalysis**    3 credits

**Instructor:** R. Le Van Mao

**Prerequisite:** Chem. 231

**For:** Optional course

**Format:** Lectures

**Basis of Grading:** Mid-term, final exam and assignments.

**Description:** Surface phenomena in heterogeneous catalysis (adsorption; texture of solids; introduction to the main techniques for the characterization of catalysts). Relationships between surface properties and catalyst activities (basic concepts in Catalysis). Catalytic kinetics. Catalytic reaction systems (introduction to the theory of catalytic reactors; diffusion, heat and mass transfer within porous solids; shape selectivity; catalyst activity decay). Industrial Catalysis : new trends.

**Note:** Students who have received credit for CHEM. 498N may not take this course for credit.

**Chemistry 446 Electrochemistry**    3 credits

**Instructor:** M.F. Bell

**Prerequisites:** Chem. 231, 331 or Department permission

**For:** Optional course

**Format:** Lectures

**Basis of Grading:** Assignments, mid-term and final exam (or research paper).

**Description:** This course covers a specialized area of physical and analytical chemistry and, in particular, develops concepts introduced in CHEM. 218 and 312. The theory behind these concepts is further described to explain the principles of corrosion and battery research and development.

**Note:** Students who have received credit for CHEM. 498O may not take this course for credit.

**Chemistry 447 Electronic Spectroscopy**    3 credits

**Instructor:** J.A. Capobianco

**Prerequisites:** Chem. 233, 341

**For:** Optional course

**Format:** Lectures

**Basis of Grading:** Paper, oral presentation of paper, final exam.

**Description:** This course is intended to provide the student with the theoretical background necessary to understand and work with electronic spectra, to illustrate and discuss the methods involved in assigning spectral transitions, and to explain the spectra which have been found for the transition metal ions in various oxidation states and symmetries.

This course assumes that the students has some knowledge of atomic structure, molecular symmetry and group theory.

**Note:** Students who have received credit for CHEM. 498R may not take this course for credit.

**Chemistry 449 Laboratory in Synthesis and Techniques in Inorganic Chemistry**                      1 credit

**Instructor:** P.H. Bird

**Prerequisite:** Chem. 442 previously or concurrently

**For:** Optional course

**Format:** Laboratory

**Basis of Grading:** Laboratory work and reports

**Description:** Some of the techniques discussed in Chem. 442 will be employed in the laboratory to characterize and determine properties of compounds synthesized in the laboratory.

**Chemistry 450 Research Project and Thesis**                      6 credits

**Instructor:** The faculty

**Prerequisite:** Third year standing in Honours Chemistry (Completed 60 credits), or permission of the Department (provided the student has a grade point average of 3.00 (B) or better, for all Core Programme Courses).

**For:** Honours programmes or students with permission

**Format:** Laboratory and conferences

**Basis of Grading:** Written thesis and oral defence of work before the faculty.

**Description:** The student works on a research project, in the student's area of concentration, selected in consultation with and conducted under the supervision of a faculty member of the Department; and writes a thesis on the results. The project is also the subject of a seminar before the Department.

**Note:** Students planning to take this course must consult with the Coordinator of Senior Theses as early as possible the year before the final year.

**Chemistry 471 Enzyme Kinetics and Mechanism**    3 credits

**Instructor:** M.J. Kornblatt

**Prerequisites:** Chem. 271; 60 credits in Chemistry

**For:** Optional course in biochemistry programmes

**Format:** Lectures

**Basis of Grading:** Mid-term, final exams, and assignments. (No supplementals allowed in this course.)

**Description:** Steady state kinetics, including the use of initial velocity studies and product inhibition to establish a kinetic mechanism; non-steady-state kinetics, isotope effects, energy of activation, etc; detailed mechanisms of selected enzymes.

**Chemistry 472 Chemical Toxicology**    3 credits

**Instructor:** M.E. Baldwin

**Prerequisites:** Chem. 271 and 3rd year standing or Department permission.

**For:** Optional course

**Format:** Lectures

**Basis of Grading:** Assignments, final exam

**Description:** Introduction to the general principles of toxicology with emphasis on the toxic effects of chemicals in humans. Dose-response relationship, types and routes of exposure, absorption and disposition of toxic substances, toxicokinetics, types of toxic response and factors affecting toxic response. Toxicity testing, risk assessment and interpretation of toxicological data.

**Note:** Students who have received credit for Chem. 498V may not take this course for credit.



**Chemistry 473 Medicinal Chemistry I** 3 credits

**Instructor:** TBA

**Prerequisites:** Chem. 271, 60 credits in Chemistry

**For:** Option in Biochemistry Specialization

**Format:** Lectures

**Basis of Grading:** Mid-term and final exams

**Description:** Physiochemical principles of drug action. Influence of solubility, surface phenomena, stereochemistry and electronic properties on drug action. Nonspecific drugs, anaesthetic, membrane-active disinfectants and antibiotics. Quantitative structure-activity relationships. Receptor theory and models, methods of receptor characterization.

**Chemistry 474 Medicinal Chemistry II** 3 credits

**Instructor:** TBA

**Prerequisites:** Chem. 473 or permission of the department.

**For:** Option in Biochemistry Specialization

**Format:** Lectures

**Basis of Grading:** Term paper and final exam

**Description:** Drugs acting on endogenous messengers and their targets: Cholinergic, adrenergic, dopaminergic and serotonergic neuronal systems. Histamine, amino acid neurotransmitters. Steroid and peptide hormones, prostaglandins. Enzymes as drug receptors. Drug design.

**Chemistry 478 Hormone Biochemistry** 3 credits

**Instructor:** J. Fraser

**Prerequisites:** Chem. 271 and third-year standing (60 crs completed)

**For:** Optional course

**Format:** Lectures

**Basis of Grading:** Mid-term and final exams

**Description:** This course deals with an in-depth study of the vertebrate hormones and involves a study of the precise chemical structure and properties of each hormone, its biosynthesis and mode of secretion from the cell. The circulating form of the hormone is examined, as well as the nature of the hormone receptor. The cellular mechanism of action and the relationship of the hormone's action to the intact animal are investigated.

**Chemistry 479 Advanced Biochemistry Laboratory** 3 credits

**Instructors:** M.J. Kornblatt, J. Powlowski

**Prerequisite:** Must have a grade of C- (grade point of 1.70) or better, in 31 credits of the 45-credit Core Programme.

**For:** Programmes in biochemistry

**Format:** Laboratory

**Basis of Grading:** Laboratory work, reports, final exam

**Description:** This course deals with the theory and practice of modern biochemical laboratory techniques. Laboratory only.

**Chemistry 481 Bioinorganic Chemistry** 3 credits

**Instructor:** A. English

**Prerequisites:** Chem. 241, 271

**For:** Optional course

**Format:** Lectures

**Basis of Grading:** Mid-term and final exams

**Description:** Role of metals in biochemical systems. Essential trace elements, zinc enzymes, oxygen transport and storage, metalloproteins and biological electron transfer, structure-function relationships in heme enzymes, nitrogen fixation; model compounds for metalloproteins and metalloenzymes.

**Chemistry 491 Advanced Instrumentation** 4 credits

**Instructor:** TBA

**Prerequisites:** Chem. 392

**For:** Optional course

**Format:** Lectures and laboratory

**Basis of Grading:** Mid-term, final exams, lab work and reports.

**Description:** A study of the amplifiers, transducers, and other circuit elements used to acquire data in chemistry, in the analog, time, and digital data domains. A study of these circuits as regards optimization, frequency response, sampling parameters, signal-to-noise enhancement and budget error analysis. Some of the concepts involved in computer interfacing, for both control and data collection, are discussed. In the laboratory, selected experiments illustrate the topics discussed in lectures. Lectures and laboratory.

**Note:** Students who have received credit for CHEM. 490 or CHEM. 497 or CHEM. 499 may not take this course for credit.

**Chemistry 492 Chemical Spectroscopy** 4 credits

**Instructor:** S. Daunt

**Prerequisites:** Chem. 324 (or 321) and 328

**For:** Optional course

**Format:** Lectures and laboratory

**Basis of Grading:** Mid-term, final exams, laboratory work and reports

**Description:** Theory and application of EPR spectroscopy, rotational spectroscopy, rotation-vibrational spectroscopy, Raman spectroscopy. Lectures and laboratory.

**Chemistry 493 Magnetic Resonance Spectroscopy** 3 credits

**Instructor:** L.D. Colebrook

**Prerequisite:** Chem. 221 or equivalent

**For:** Optional course

**Format:** Lectures

**Basis of Grading:** TBA

**Description:** This course is designed to provide the background in magnetic resonance theory necessary to understand modern high-resolution NMR experiments and instrumentation. The basic theory in the introductory section also applies to electron spin resonance (ESR). Relaxation and through-bond and through-space interactions, and experiments to investigate them, are considered. Spin manipulations and behaviour in multiple-pulse, Fourier transform NMR techniques used for common spectral editing and two-dimensional experiments are discussed.

**Note:** Students who have received credit for Chem. 498L may not take this course for credit.



**Chemistry 494 Mass Spectrometry 3 credits****Instructor:** R.T. Rye**Prerequisite:** Chem. 331**For:** Optional course**Format:** Lectures**Basis of Grading:** Mid-term and final exams.

**Description:** Production and interpretation of mass spectra. Topics to be covered will include: ionization methods (electron impact, chemical ionization and fast-atom bombardment); interpretation of mass spectra; introduction to quantitative analysis by mass spectrometry.

**Note:** Students who have received credit for Chem. 498T may not take this course for credit.

**Chemistry 498 Advanced Topics in Chemistry 3 credits**

Courses under this number and heading are scheduled as the demand and opportunity arises. There is no guarantee that a particular topic will be scheduled in any particular year. Students are advised to consult the schedule.

Some topics that have been offered in the past few years are noted below:

- Membrane Biochemistry
- Advanced Bio-organic Chemistry
- Heterocyclic Chemistry (See Chem. 423)
- Magnetic Resonance Spectroscopy (see Chem. 493)
- Mössbauer Spectroscopy and Magnetic Properties of Materials (see Chem. 444)
- Electrochemistry (see Chem. 446)
- Photochemistry
- Electronic Spectroscopy (see Chem. 447)
- Crystal Chemistry
- Mass Spectroscopy
- Bio-analytical Chemistry
- Catalytic Processes in the Chemical Industry
- Homogeneous Catalysis
- Statistical Methods in Chemistry (see Chem. 412)
- Single Crystal X-Ray Diffraction (see Chem. 441)
- Neurochemistry
- Organometallic Chemistry
- Thermodynamics of Irreversible Processes

**Chemistry 499 Advanced Topics in Chemistry 6 credits**

See "Note" for Chem. 498